

CLAIMS

What is claimed is:

1           1.     In a voice communication system, wherein transmission of voice information  
2 through an interface is represented by successive data frames respectively contained in a  
3 succession of pitch synchronous frames, and at least one of the data frames is subject to being  
4 lost, a method for improving quality of the voice information at a receiving side of the system,  
5 the method comprising the steps of:

6                     detecting the loss of a particular data frame at said receiving side; and

7                     replacing the particular pitch synchronous frame containing said lost data frame  
8 with a replica of the pitch synchronous frame immediately preceding said particular pitch  
9 synchronous frame in said succession.

1           2.     The method of Claim 1 wherein said detecting step comprises:

2                     detecting a loss of signal energy associated with said particular pitch synchronous  
3 frame.

1           3.     The method of Claim 1 wherein said detecting step comprises:

2                     computing a threshold value associated with said particular pitch synchronous  
3 frame; and

4                     selectively comparing an average magnitude of said particular pitch synchronous  
5 frame with said threshold value.

1           4.     The method of Claim 3 wherein:  
2                 a difference value is computed by subtracting said average magnitude of said  
3 particular pitch synchronous frame from an average magnitude associated with said immediately  
4 preceding pitch synchronous frame, loss of said particular pitch synchronous frame being  
5 indicated if said difference value exceeds said threshold value.

1           5.     The method of Claim 1 wherein:  
2                 said method includes the step of estimating a threshold based pitch synchronous  
3 period associated with said transmitted voice information.

1           6.     The method of Claim 5 wherein said estimating step comprises:  
2                 generating a train of signal samples from said voice information, said samples  
3 collectively representing a succession of signal waveforms;  
4                 identifying respective positive peaks of said waveforms; and  
5                 computing the period between two consecutive peaks to provide said pitch synchronous  
6 period estimate.

1           7.     The method of Claim 6 wherein:  
2                 said communication system comprises a Bluetooth voice transmission system.

1           8.     The method of Claim 1 wherein:  
2                 said system is disposed to mute transmitted data frames affected by interference in  
3 said transmission interface.

1           9.     A method for transmitting voice information through an air interface comprising  
2 the steps of:

3                 transmitting a succession of data frames of signal samples collectively  
4 representing said information into said interface, from a transmission side thereof, said data  
5 frames respectively contained in a succession of pitch synchronous frames;

6                 muting a data frame which becomes lost in said interface;

7                 receiving said succession of pitch synchronous frames, including a particular  
8 pitch synchronous frame containing said muted data frame, at a receiving side of said interface;

9                 detecting said muted data frame in said particular pitch synchronous frame at said  
10 receiving side; and

11                replacing said particular pitch synchronous frame with a replica of the frame  
12 immediately preceding said particular pitch synchronous frame in said pitch synchronous  
13 succession.

1           10.    The method of Claim 9 wherein said detecting step comprises:

2                 computing a threshold value associated with said particular pitch synchronous  
3 frame; and

4                 selectively comparing an average magnitude of said particular pitch synchronous  
5 frame with said threshold value.

1 11. The method of Claim 10 wherein:

2 a difference value is computed by subtracting said average magnitude of said  
3 particular pitch synchronous frame from an average magnitude associated with said immediately  
4 preceding frame, loss of said muted data frame being indicated if said difference value exceeds  
5 said threshold value.

1 12. The method of Claim 11 wherein:

2 said method includes the step of estimating a pitch period associated with said  
3 transmitted voice information.

1 13. In a voice communication system, wherein transmission of voice information  
2 through an interface is represented by data frames respectively contained in a succession of pitch  
3 synchronous frames and at least one of the data frames is subject to being lost, apparatus for  
4 improving quality of the voice information at a receiving side of the system comprising:

5 a lost frame detector for detecting the loss of a data frame at said receiving side;

6 and

7 an error concealment device for replacing the particular pitch synchronous frame  
8 containing the lost data frame with a replica of the pitch synchronous frame immediately  
9 preceding said particular pitch synchronous frame in said succession.

1 14. The apparatus of Claim 13 wherein said lost frame detector is disposed to detect a  
2 loss of signal energy associated with said particular pitch synchronous frame.

1           15.    The apparatus of Claim 13 wherein:

2                   said detector is disposed to compute a threshold value associated with said  
3 particular pitch synchronous frame and to selectively compare an average magnitude of said  
4 particular pitch synchronous frame with said threshold value.

1           16.    The apparatus of Claim 15 wherein:

2                   said lost frame detector computes a difference value by subtracting said average  
3 magnitude of said particular pitch synchronous frame from an average magnitude associated with  
4 said immediately preceding frame, loss of the data frame in said particular pitch synchronous  
5 frame being indicated if said difference value exceeds said threshold value.

1           17.    The apparatus of Claim 13 wherein:

2                   said apparatus includes a device for estimating a pitch period associated with said  
3 transmitted voice information.

1           18.    The apparatus of Claim 17 wherein said pitch estimating device is disposed to:

2                   generate a train of signal samples from said voice information, said samples  
3 collectively representing a succession of signal waveforms;  
4                   identify respective positive peaks of said waveforms; and  
5                   compute the period between two consecutive peaks to provide said pitch period  
6 estimate.

1           19.    The apparatus of Claim 13 wherein:

2                   said communication system comprises a Bluetooth voice transmission system.

- 1           20.    The apparatus of Claim 13 wherein:
- 2                   said system is disposed to mute transmitted data frames affected by interference in
- 3   said transmission interface.